The Korean Intellectual Property Office (KR)
Registered Patent (B1)

(51) Int.Cl.
H01L 33/00

(11) Registration No	10-0226831		
(24) Registration Date	1999-07-29		
(45) Published Date	1999-10-15		
(21) Application No	10-1996-0047113	(65) Unexamined Publication No	10-1998-0028124
(22) Application Date	1996-10-21	(43) Unexamined Publication Date	1998-07-15
(74) Agent	Yong-In Kim Chang-Seop Shim	(72) Inventor	Cha-Yeon Kim
(73) Right Holder	LG ELECTRONICS INC. Ja-Hong Gu		

Examiner : Dong-Yeop Kim

(54) LIGHT EMITTING DIODE AND A METHOD OF MANUFACTURE THEREOF.

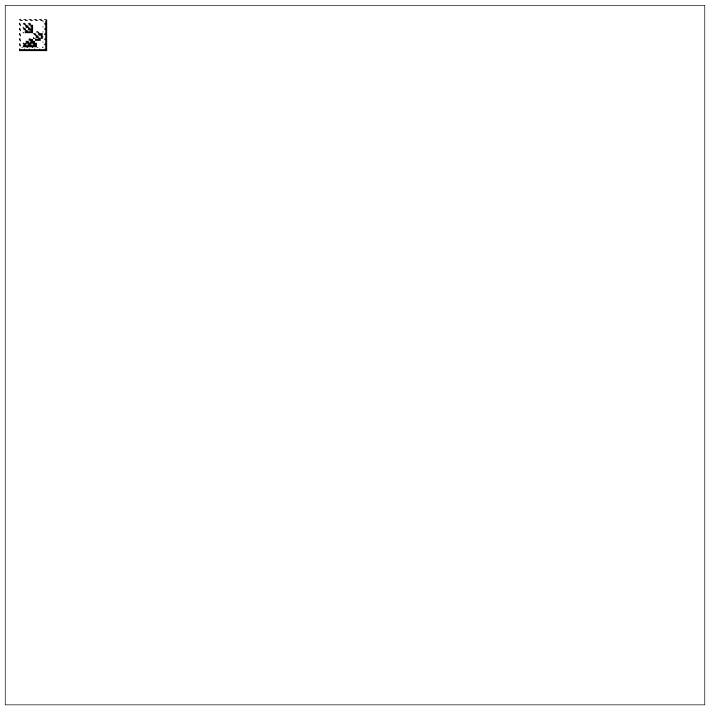
Abstract

Machine Translation

1

At the same time, the electrode in which the process is complicated and which is comprised of the electrode metallization of the GaTi layer on n-type and p-type epitaxial layer the nonefficient problem is solved, al layer and au layer is formed into the thing about light emitting diode and a method of manufacture thereof. After photoresist is formed on electrode on the p-type epitaxial layer the front side, it heat-treats in one mood among temperature and NH_3, N2 of 500~900℃ and n-type and P-contact are formed. In that way the light emitting diode in which the process is simple and the conductivity is improved can be made.

Representative drawing



Description

Brief explanation of the drawing

2 The 1a, in other words. And figure 1d is a processing sectional view showing the manufacturing process of th emitting diode according to prior art.

3 The 2a, in other words. And figure 2d is a processing sectional view showing the manufacturing process of th emitting diode.

4 Fig. 3 is a structure sectional diagram showing the light emitting diode.

5 The description of reference numerals of the main elements in drawings.

6 11: substrate 12: n-epitaxial layer.

7 13: active layer 14: p-type epitaxial layer.

8 15: gaTi layer 16: al layer.

9 17: au layer 18: photoresist.

Details of the Invention

Purpose of the Invention

The Technical Field to which the Invention Belongs and the Prior Art in that Filed

10 The present invention relates to the light emitting diode, particularly, to the light emitting diode forming electro regardless of the doping type and a method of manufacture thereof.

11 If below, referring to the figure, referring to the figure, and the attached manufacturing method are explained,

same as that of the next time.

12 Figs. 1a through Figs. 1a are the processing sectional view showing the manufacturing process of the light er diode according to prior art.

13 As shown in Fig. 1a, the N-epitaxial layer (2) doping the n-type impurity on the sapphire substrate (1) is grown constant thickness. And the p-type epitaxial layer (4) which consecutively dopes the active layer (3) and p-typ impurity on the N-epitaxial layer (2) is grown to the constant thickness.

14 At this time, si is used as the n-type impurity and Mg is used as the p-type impurity. And n-type and p-type ep layers (2,4) are done by GaN.

15 As shown in Fig. 1b, the active layer (3) and p-type epitaxial layer (4) are selectively removed to the photolithographical (photolithogrphy) and etching process and the constant area of the N-epitaxial layer (2) is

16 As shown in Fig. 1c, the first photoresist is coated n-type and p-type epitaxial layer (2,4) front side with and it and the constant area of the N-epitaxial layer (2) is exposed. And the ti layer (5), al layer (6), with the Ti layer layer (7) is successively formed on the first photoresist front side including the exposed N-epitaxial layer (2) a first photoresist and the ti layer (5), al layer (6), with the Ti layer (5), au layer (7) formed on the first photoresis removed to the lift-off process and N type electrode is formed.

17 As shown in Fig. 1d, the second photosensitive film is coated n-type and the p-type epitaxial layer (2,4) front s including N type electrode with and it patterns and the constant area of the p-type epitaxial layer (4) is expose the ti layer (5), cr layer (8), with the Ti layer (5), au layer (7) is successively formed on the second photosensi front side including the exposed p-type epitaxial layer (4) and the formed ti layer (5), cr layer (8), with the Ti la au layer (7) is removed to the lift-off process on the second photosensitive film and the second photosensitive P-contact is formed.

18 The structure is as follows: If the structure of light emitting diode formed in this way is illustrated.

19 As shown in Fig. 1d, it is composed of the P-contact consisting of N type electrode, and the Ti layer (5), the C (8), and the Ti layer (5) and Au layer (7) it is formed in the constant area on the p-type epitaxial layer (4) cons the N-epitaxial layer (2) formed on the sapphire substrate (1), the active layer (3) and the p-type epitaxial laye formed in the constant area on the N-epitaxial layer (2), and the Ti layer (5), the Al layer (6), and the Ti layer (Au layer (7) it is formed in the task forward reverse reverse on the N-epitaxial layer (2).

Technical challenges of the Invention

20 The light emitting diode according to prior art and manufacturing method have the following problems:.

21 In the first, and the n-type in the electrode metallization, by classifying according to the Au / Ti / Cr / Ti in the / Al / Ti, and p-type and forming the process is complicated and it is nonefficient.

22 In order to make the light emitting diode in which the conductivity is good, in case of the high doping to being making the high doping the crack etc. are formed with the dopant as the in the epitaxial layer and the yield of emitting diode is lowered with second.

23 It is an object of the present invention to provide the light emitting diode iss designed to solving, and forms el regardless of the doping type and simplifies the process and a method of manufacture thereof this kind of pro

24 It is another object of the present invention to provide the light emitting diode in which it takes shape the struc electrode in order to be high-doped in the epitaxial layer and the conductivity is improved and a method of manufacture thereof.

‣ Structure & Operation of the Invention

25 There can be the feature it is made as in the light emitting diode and manufacturing method, N type electrode contact the GaTi layer, the Al layer, and the Au layer for achieving this kind of purpose.

26 At the same time, other feature of the present invention forms N type electrode and P-contact.

27 After another characteristic of the present invention forms photoresist on electrode on the p-type epitaxial lay front side, it heat-treats.

28 It heat-treats another characteristic of the present invention in one mood among temperature and NH_3, N2 o 500~900℃.

29 As described in detail, it is the same as that of the next time than the drawing which is and manufacturing me attached.

30 Figs. 2a through Figs. 2a are the processing sectional view showing the manufacturing process of the light er diode.

31 As shown in Fig. 2a, the N-epitaxial layer (12) doping the n-type impurity on the sapphire substrate (11) whic cleanly washes is grown to the constant thickness. And the p-type epitaxial layer (14) which consecutively do active layer (13) and p-type impurity on the N-epitaxial layer (12) is grown to the constant thickness.

32 At this time, n-type and p-type epitaxial layers (12, 14) are done by GaN.

33 Subsequently, the active layer (13) and p-type epitaxial layer (14) are selectively removed to the photolithogr (photolithogrphy) and etching process and as shown in the figure, the constant area of the N-epitaxial layer (1 exposed with the drawing 2b ***.

34 And as shown in Fig. 2c, after the GaTi layer (15), and the Al layer (16) and Au layer (17) are successively fo n-type and p-type epitaxial layers (12, 14), the GaTi layer (15), and the Al layer (16) and Au layer (17) are pat and the first electrode is formed on the constant area of the N-epitaxial layer (12). The second electrode is fo the constant area of the p-type epitaxial layer (14).

35 At this time, the thickness of the GaTi layer (15) forms into 200~300Å.

36 And the Al layer (16) between the Au layer (17) and the GaTi layer (15) play the barrier role protecting the rea between the GaTi layer (15) and the Au layer (17).

37 Subsequently, as shown in Fig. 2d, the photoresist (18) is formed on n-type and the p-type epitaxial layer (12, side including first, and second electrode and it patterns and the second electrode is exposed. And the front s including the exposed second electrode is heat-treated and the first electrode forms into n-type and the secor electrode forms into p-type.

38 At this time, the thermal process is comprised of the temperature of NH3 or the N2 mood and about 500~900

39 In this way, the reason why the first, and the doping type of the second electrode are determined by heat-trea as follows.

40 In NH3 or the N2 mood, it unites with N and exposed lower-part , and the GaTi layer (15) of the second electr make GaTiN the thermal process.

41 The GaTi layer (15) formed in the interface of the p-type epitaxial layer (14) consists of GaTiN. In that way it p that N is diffused to the GaTi layer (15) and it comes from the GaN of the p-type epitaxial layer (14) and rathe more diffused to the p-type epitaxial layer (14) and many hole carrier are formed.

42 Moreover, it seems to be heat-treated in the standby state at the first electrode since nots being exposed to N N2 mood.

43 Therefore, in the GaN of the N-epitaxial layer (12), by being diffused to the GaTi layer (15) in which N are forr the interface of the N-epitaxial layer (12) and freeing from many electronic carrier (electron carrier) are formed N-epitaxial layer (12).

44 And the light emitting diode removing the photoresist (18) remaining as the next process and can form electrc regardless of the doping type is completed.

45 Fig. 3 is a structure sectional diagram showing the light emitting diode.

46 As shown in Fig. 3, it is composed of the P-contact consisting of N type electrode, and the GaTi layer (15), ar layer (16) and Au layer (17) it is formed in the constant area on the p-type epitaxial layer (14) consisting of the epitaxial layer (12) formed on the sapphire substrate (11), the active layer (13) and the P-type epitaxial layer formed in the constant area on the N-epitaxial layer (12), and the GaTi layer (15), and the Al layer (16) and Al (17) it is formed in the constant area on the N-epitaxial layer (12).

Effects of the Invention

47 As to light emitting diode and manufacturing method, it has effect as follows.

48 At the same time, by forming electrode regardless of the doping type the process can be simplified and efficie be enhanced with first.

49 By heat-treating in the NH_3 or N_2 mood the doping type is determined and it is high-doped in the epitaxial lay same time the light emitting diode in which the conductivity is improved can be made with second.

Scope of Claims

Claim [1] :

50 The light emitting DIODE, wherein it is made including the step of heat-treating the front side including the firs step of forming photoresist on the second epitaxial layer front side and patterning and exposing the second el and the second electrode including the first epitaxial layer in the top of the substrate, the step of successively the active layer and the second epitaxial layer, the step of patterning the active layer and the second epitaxial and exposing the constant area of the first epitaxial layer, the step of successively forming the first, the secon the metal three layer on the first, and the second epitaxial layer, the step of patterning the first, the second, ar metal three layer and forming the first electrode on the constant area of the first epitaxial layer and forming th electrode on the constant area of the second epitaxial layer, and the first, and the second electrode and remc photoresist.

Claim [2] :

51 The light emitting DIODE of claim 1, wherein the first, and the second epitaxial layer form into GaN.

Claim [3] :

52 The light emitting DIODE of claim 1, wherein in the first metal layer, the second metal layer the metal three la into GaTi into Al into Au.

Claim [4] :

53 The light emitting DIODE of claim 1, wherein the thickness of the first metal layer forms into 200~300Å.

Claim [5] :

54 The light emitting DIODE of claim 1, wherein the thermal process is made of the temperature of 500~900℃.

Claim [6] :

55 The light emitting DIODE of claim 1, wherein the thermal process is comprised of one mood among the NH_3

Claim [7] :

56 The light emitting diode, wherein it is comprised of the second electrode consisting of the first electrode, and t layer, the Al layer, and the Au layer it is formed in the constant area of the second epitaxial layer consisting of epitaxial layer formed in the top of the substrate, the active layer and the second epitaxial layer, and the GaTi the Al layer, and the Au layer it is formed in the constant area of the first epitaxial layer, and the active layer a second epitaxial layer is laminated in the constant area of the first epitaxial layer and is formed.

Claim [8] :

57 The light emitting diode of claim 7, wherein the first, and the second epitaxial layer are formed with GaN.